T03D07 – HL Periodicity Exam MS

1. C **(5)**
2. A **(5)**
3. B **(5)**
4. B **(3)**
5. C **(5)**
6. C **(4)**
7. B **(5)**
8. A **(5)**
9. A **(5)**
10. D **(4)**
11. C **(4)**
12. D **(5)**
13. C **(5)**
14. D **(4)**
15. A **(4)**
16. C **(5)**
17. B **(3)**
18. D **(5)**
19. B **(6)**
20. B **(6)**
21. D **(6)**
22. A **(6)**
23. A **(6)**

IB Chem HL1		**Free Response Section (Paper 02)**												
Level:	Needed	**Grade**	**Possible**	**3**		**4**		**5**		**6**		**7**		**Cutoff**
Above +6	0%	**2**	0	55%	3.2	45%	0	35%	6.65	20%	2.4	10%	0.5	**13**
Above +5	10%	**3**	4	80%	3.2	55%	0	45%	8.55	35%	4.2	20%	1	**17**
Above +4	20%	**4**	0	90%	3.6	80%	0	55%	10.5	45%	5.4	35%	1.8	**21**	BELOW
Above +3	35%	**5**	19	95%	3.6	90%	0	80%	15.2	55%	6.6	45%	2.3	**28**	STANDARD
Above +2	45%	**6**	12	100%	4	95%	0	90%	17.1	80%	9.6	55%	2.8	**33**	ABOVE
Above +1	55%	**7**	5	100%	4	100%	0	95%	18.1	90%	11	80%	4	**37**
Level	**80%**	**Multiple Choice Section (Paper 01)**												
Below -1	90%	**Grade**	**Possible**	**3**		**4**		**5**		**6**		**7**		**Cutoff**
Below -2	95%	**2**	0	55%	1.6	45%	2.25	35%	3.85	20%	1	10%	0	**9**
Below -3	100%	**3**	2	80%	1.6	55%	2.75	45%	4.95	35%	1.8	20%	0	**11**
Below -4	100%	**4**	5	90%	1.8	80%	4	55%	6.05	45%	2.3	35%	0	**14**	BELOW
Below -5	100%	**5**	11	95%	1.8	90%	4.5	80%	8.8	55%	2.8	45%	0	**18**	STANDARD
Below -6	100%	**6**	5	100%	2	95%	4.75	90%	9.9	80%	4	55%	0	**21**	ABOVE
Below -7	100%	**7**	0	100%	2	100%	5	95%	10.5	90%	4.5	80%	0	**22**

24. ***alkali metals:***
(5x1)metallic bonding/a bed of cations in a sea of electrons;
(6x1)as radius increases down the group, valence electrons are further away from nucleus (and strength of metallic bonding decreases);
halogens:
(5x1)non-polar/van der Waals' forces between molecules;
(6x1)as size increases van der Waals' forces increase (and melting point increases);
period 3 elements:
(6x1)increase in melting points of metals (Na, Mg, Al) due to increase in number of valence electrons **and** decrease in size/the way atoms are packed as solids;
Award mark just for "increased number of delocalized or valence electrons".
silicon:
(7x1)network covalent solid (with very high melting point);
Award mark also for "many or strong covalent bonds".
P → Ar:
(6x1)simple molecular (atomic in case of Ar) substances with weak van der Waals' forces (and lower melting points);
(7x1)trend in P_4, S_8, Cl_2, Ar due to size/mass of particles; 8
Award mark for "decreasing mass or size".
Molecular formulae not necessary.

[8]

25. ***Li to Cs***
(3x1)atomic radius increases;
(5x1)because more full energy levels are <u>used</u> or <u>occupied</u>/<u>outer</u> electrons further from nucleus/outer electrons in a higher shell;
(3x1)ionization energy decreases;
(5x1)because the electron removed is further from the nucleus/increased repulsion by inner-shell electrons; 4
Accept <u>increased</u> shielding effect.

(ii) ***Na to Cl***
(3x1)atomic radius decreases;
(5x1)because nuclear charge increases **and** electrons are added to same main (outer) energy level;
(3x1)ionization energy increases;
(5x1)because nuclear charge increases **and** the electron removed is closer to the nucleus/is in the same energy level; 4

Accept "core charge" for "nuclear charge". In (i) and (ii) explanation mark dependent on correct trend. **[8]**

26. (i) **(5x1)**NaCl conducts **and** $SiCl_4$ does not;
(6x1) NaCl ionic **and** $SiCl_4$ covalent;
(7x1)ions can move in liquid (in NaCl)/*OWTTE*; 3

(ii) **(6x1)**NaCl pH = 7;
(7x1)salt of strong acid and strong base/Na^+ and Cl^- not hydrolysed;
(6x1)$SiCl_4$ pH = 0 to 3;
(7x1)HCl is formed/strong acid formed; 4

[7]

27. (i) **(6x1)**an ion or molecule, with <u>a lone pair of electrons</u> that coordinates to a metal atom or to a metal ion to form a complex/(*OWTTE*) **and** cyanide/CN^-; 1

(ii) **(5x1)**Fe^{3+} = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$;

(5x1) [Ar]

↑	↑	↑	↑	↑

;

$3d^5$

(6x1)5 unpaired electrons; 3

(iii) presence of unpaired electrons;
the d orbitals are split into two energy levels;
electrons move between these energy levels;
absorb energy from light of visible wavelength/*OWTTE*; 3 max

*(**5x1,6x2**)Award **[1]** each for any three.*

[7]

28. (a) **(5x1)** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^2$/[Ar] $4s^2\ 3d^{10}\ 4p^2$; 1

Do not penalize for interchanging $4s^2$ and $3d^{10}$.

(b) (i) **(5x1)** (4)p; 1

(ii) **(5x1)**$Ge^+(g) \rightarrow Ge^{2+}(g) + e^-$; 1

Do not penalize for $e^-(g)$.
Accept loss of electron on LHS.

(iii) **(6x1)**5th electron removed from energy level closer to nucleus/5th electron removed from 3rd energy level and 4th electron from 4th energy level/*OWTTE*;
(5x1)attraction by nucleus or protons greater (for electrons closer to nucleus)/*OWTTE*; 2

[5]

29. **(5x5)**$n(Fe_2O_3) = 30\times10^3\div159.7$/$n(Fe_2O_3)$ = 188 mol;
$n(C) = 5.0\times10^3\div12.01$/n(C) = 416 mol;
Fe_2O_3 is the limiting reagent or implicit in calculation;
$n(Fe) = 2\times n(Fe_2O_3) = 2\times188 = 376$ mol;
$m(Fe) = 376\times55.85$ = 21 kg;

Accept 2 sig. fig. or 3 sig. fig., otherwise use □1(SF).
*Correct final answers score **[5]**.*
Allow ECF.

[5]